

MOORE The Value of Tuberculin in the Control of Tuberculous

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Veranus Alva Moore, B.S., M.D., V.M.D.

Professor of Comparative Pathology & Bacteriology
& Meat Inspection.

Dean of the College

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THE VALUE OF TUBERCULIN IN THE CONTROL OF
TUBERCULOUS HERDS.BY VERANUS A. MOORE,
Cornell University, Ithaca, N. Y.

The awakening to the fact that tuberculosis existed to any considerable extent in the cattle of America was a result of the discovery of tuberculin by Robert Koch and its later application as a diagnostic agent. A careful inquiry into the extent and distribution of bovine tuberculosis shows that it is most prevalent in those districts where there has been the greatest interchange of cattle. As its dissemination depends largely upon the introduction of infected individuals, it was not strange that with an unrestricted cattle traffic many infected animals were innocently bought and sold, thereby carrying the disease and spreading its virus. The usual slow development of tuberculous lesions in cattle, and the fact that many infected individuals are spreading the bacilli before their true condition is suspected, made it possible for a large number of herds to become extensively diseased as a result of the increase in cattle traffic caused by the constantly growing demand of our large cities for milk.

When the extent of bovine tuberculosis was first ascertained, there was a tendency to radical State control and slaughter of infected animals, because of its supposed sanitary significance. The disease appeared to be one of such magnitude that the people looked to the State for both counsel and financial assistance in its eradication. The State efforts by legislation and official control, however, have not eliminated it as quickly as was generally anticipated. With a growing knowledge of tuberculosis and its parasitic nature, we are coming to realize more and more that it is not so much a matter of State as it is one for the individual to deal with. Like a noxious plant, its seed must be kept out. While the State and nation have their responsibilities concerning it, the individual cattle-owner must in the last analysis see to it that his herd is protected from infection, which usually comes with the purchase of tuberculous cattle or the feeding of milk from tuberculous cows to calves. It is therefore largely a personal problem, the solution of which is to be found in the methods adopted and followed by the individual owner, protected by proper legislation, and given as much other assistance by the State as the legislature may see fit to confer. The burden of the effort to eliminate bovine tuberculosis is with the individual farmers in whose herds the disease

may exist. The work before us is to formulate methods that will enable individual cattle-owners to apply the present knowledge of tuberculosis to the existing conditions in their herds with the least loss and with the quickest returns. It is my purpose, therefore, to discuss the subject of bovine tuberculosis as an individual matter, and to point out the value of tuberculin in this personal conflict with it.

As tuberculin made it possible to determine the presence of tuberculous infection, it is also the one indispensable agent to rely upon in the control of this parasitism. While many of our States have passed laws relative to the use of tuberculin in the official effort to control tuberculosis, a large number of cattle-owners have privately attempted to eradicate it by the same means. In New York I have collected some data on this point. In 1907 I secured the results of the tests made (1904-06) with tuberculin on 683 herds, containing a total of 12,721 animals. Of these, only 262 herds, including 3088 animals, were tested by the State, while 421 herds with 9633 animals had been thus examined by privately employed veterinarians. The practical dairymen have come to recognize the inefficiency of a physical examination and the necessity for some specific reaction to detect tuberculous infection. This has caused the value of tuberculin to be appreciated and employed by a steadily increasing number of cattle-owners.

In using tuberculin certain apparent discrepancies have appeared, which have caused many dairymen to question its value. This is due to the lack of knowledge concerning it. The dairyman does not distinguish between active, healed, or latent tuberculous lesions, and up to a comparatively recent date pathologists have been unable to instruct them in the significance of these technical differences. It is important, however, that the interpretation of the reaction or non-reaction to tuberculin should be clearly understood. The experience of the last few years has called into question certain interpretations and conclusions concerning its accuracy that heretofore were accepted. The findings of Carini, that failure of tuberculin may be expected in about 17 per cent. of cases, and of Lignières, that a tolerance may be established which results in a failure of the tuberculin to give a reaction in certain cases where later post-mortems reveal the presence of tuberculous lesions, have been somewhat general when tuberculin has been applied under certain conditions. The phenomenon of the tuberculin reaction has not been satisfactorily elucidated. The explanation offered some ten years ago by Eber, and recently modified by Smith, will, if correct, do much to clarify the confusion regarding the non-reaction to tuberculin in cases where there are healing tuberculous lesions. According to this theory, for the action of tuberculin, "the tubercle bacilli have induced certain tissue changes, and with them certain new functions of the tissues have been aroused, which are the result of immunization." It is the action of the specific product result-

ing from these changes upon the tuberculin that causes the latter to split off a poisonous substance which causes the elevation of temperature.

A study of tuberculous lesions shows that when the process of healing begins, there is formed about the foci a wall of fibrous or fibrous and cellular tissue, which tends, to a certain degree, to separate the lesion from the surrounding tissue and the circulation. The specific product resulting from the tissue changes as stimulated by the tubercle bacilli in the focus is therefore largely confined to the diseased area, and cannot act upon the tuberculin if it is subsequently injected. This explains the failure of tuberculin to react in those cases where tubercles are healing. As a small part of the specific product of the tubercle may be disseminated in the circulation or surrounding tissues, and as its elimination may be slow, it is not unlikely that the partial reactions that often occur may be explained on the hypothesis that there still remains enough of the specific substance to liberate poison sufficient to disturb the temperature, but not to cause a characteristic rise. More extended investigations are necessary to determine at what stage in the healing process reaction ceases either in part or completely. It is presumable that a number of conditions contribute to this result. In an experiment with 17 tuberculous cows, 12 failed after a certain time to react. The post-mortem examinations revealed lesions that were small and few in number, and in all cases but one they showed evidence of healing. In four of the five cases that reacted quite as much reactionary tissue existed about the tuberculous foci as there was about those in the animals that failed to react. In one the disease was very active and general. In other words, the line of demarcation between the lesions in animals that react and those that fail to do so is not always apparent. Likewise, the failure of the animals to react during the period of incubation, and the reaction that occurs before lesions are in evidence, bring us to another point that must be recognized and explained on the same basis. Because of these limitations of tuberculin, results have been accepted as failures when the conditions were such that the tuberculin could not cause a reaction, or when the reactions have occurred before the lesions were of sufficient size to be readily found, or were localized in organs and tissues not ordinarily examined.

In the application of tuberculin by veterinarians for eradicating tuberculosis in private herds it is very important that the limitations of its action be fully appreciated and explained to the owners. This is desirable in order that the necessary precautions may be taken and the expectations of the owner so adjusted that he will not be disappointed by the future results. The tendency of cattle-men to believe that when an animal fails to react or ceases to react, if it has previously done so, it is perfectly safe to be placed with sound animals, cannot be overcome without duly acquainting them with the facts. If the limitations of tuberculin and the possibilities of infection are

taken into account, the conservative method of dealing with bovine tuberculosis, as first recommended by Professor Bang, has great possibilities. In the State of New York it has been applied in a number of private herds with excellent results. In certain breeding herds it has been the means of saving valuable strains of animals. After separating those that respond at the first test, repeated injections at proper intervals have pointed out the individuals that were infected, but did not respond in the beginning. The breeding from the infected animals has been successful, so that the infected individuals have been replaced by sound ones. The infected animals are eventually a loss to the owner beyond what beef value they may possess; but valuable strains have been preserved, so that the final depreciation is not serious. There are scores of infected herds in New York State that are being replenished with sound animals after this method, and the Commissioner of Agriculture of that State is recommending it to the dairymen generally.

The real purpose of the Bang method is to build up a sound herd from a tuberculous one. The existing conditions relative to the duration and extent of the infection are important factors in considering the probable outcome of non-reacting animals in the original herd. In certain herds where the Bang method has been applied under my personal observation the results have been quite different respecting the original non-reacting animals. In one case where there were 17 reacting and 13 sound individuals, but one of the 13 subsequently reacted, although tested semi-annually for four years. In other herds a much larger percentage of the supposed sound animals were victims of this insidious infection.

In one herd of 491 animals tested there were 96 cows that did not react. These were placed by themselves in a practically new barn, and three months later, and every six months thereafter, the sound herd was tested. Those that responded were promptly removed and the stable thoroughly disinfected with 5 per cent. carbolic acid after each test. The results of the consecutive tests of the non-reacting animals are exceedingly instructive. They are as follows:

1904.	July.....	96 tested; 31 reacted, 65 did not react; 32.2% reacted.
1905.	Jan.....	65 " 8 " 57 " " " 12.3 "
	July.....	57 " 15 " 42 " " " 26.3 "
1906.	Jan.....	42 " 15 " 27 " " " 35.7 "
	July.....	27 " 3 " 24 " " " 11.1 "
1907.	Jan.....	24 " 2 " 22 " " " 8.3 "
	July.....	22 " 1 " 21 " " " 4.5 "
1903.	Jan.....	21 " 1 " 20 " " " 4.7 "
	Aug.....	20 " 1 " 19 " " " 5.0 "

During this time these animals were kept by themselves. There was no opportunity for infection after they were removed from the general herd. Several of the reactors were examined post mortem. The lesions were slight in extent, but of long standing. They were surrounded by a wall of fibrous

tissue. The conclusion seems to be warranted that these animals were infected while associating with the diseased cattle, and that the lesions had become arrested before the first test was made. The lesions in those examined post mortem were too old and the tests were made too frequently to suspect that they could have started and reached the stage of development found in the short time between tests. The repeated tests of the reacting animals in the same herd support this hypothesis. The tuberculin test, made three months later, showed fully 25 per cent. of non-reactors. Several of these continued not to respond, while others reacted again later. This oscillating of the morbid process between an active and an arrested condition is an important factor in considering the future of the supposed healthy animals and in interpreting the tuberculin reaction.

In addition to the value of tuberculin in eradicating tuberculous infection from a herd it is indispensable in examining cows to be purchased in order to prevent its introduction. If they fail to react, and they come from infected herds, it is very necessary that the test be repeated. Experience has shown that when a herd becomes extensively infected (50 per cent. or more reacting), a considerable number of the non-reactors are suffering from latent or dormant tuberculosis, which may become active later. The failure to recognize this fact has caused the disease to reappear in many herds where the reacting animals from the first test had been destroyed. This is illustrated from the following observation: In July, 1906, 92 cows from a tuberculous district were purchased on the tuberculin test. They were tested every six months thereafter. They were kept by themselves for a year, and were never exposed to known infected cattle after their purchase. The results of the subsequent tests are as follows:

1907.	June.....	92	tested; 0	reacted.					
	June.....	92	" 3	" 89	did not react;	3.3%	reacted.		
1908.	Jan.....	89	" 24	" 65	" " "	26.9	"		
	Aug.....	65	" 4	" 61	" " "	6.2	"		

In 1907 there were purchased for a dairy herd on the tuberculin test 65 cows from a dealer who had secured them from a district in which there is considerable tuberculosis. At the same time 52 cows were bought from a herd that has been kept free from this disease. The results of the subsequent tests of these two groups of cattle which were kept separate and not exposed to other diseased animals are instructive:

(1) COWS FROM INFECTED HERDS.

1908.	Jan.....	65	tested;	17	reacted,	48	did not react;	26.2%	reacted.
	Aug.....	48	"	0	"	48	" " " "	0	"

(2) COWS FROM A TUBERCULOSIS-FREE HERD.

1908.	Jan.....	52	tested,	0	reacted.
	Aug.....	52	"	0	"

These animals were exposed to as much infection—if there was any at all—in barns and pastures as the previously mentioned cases. It is unfortunate that we have not records of these animals extending over a longer period of time, but they are sufficient to point out the importance of considering both the accuracy of tuberculin and its limitations.

Tuberculosis is unlike most other infectious diseases in that the tuberculous animals still retain their beef and breeding values if the disease is detected early. It is this intrinsic value of the slightly infected animal, in some cases exceeding its value as a milk producer, which justifies the opinion set forth in this paper, that for the best and quickest results in eliminating bovine tuberculosis it must be controlled in individual herds. It is in this connection that the subject comes close to the practising veterinarians, who, as guardians of the health of the animals, have not only great responsibilities concerning the prevention of this disease, but also unlimited opportunities.

The work in New York has pointed out very clearly the danger of building up herds with non-reacting individuals taken from herds in which there is a greater or less amount of tuberculosis. The sound herd, rather than non-reacting individuals, should be sought for by the purchaser. This will require more attention to breeding and less indiscriminate buying of cattle. The essential facts that have been elicited from the results of our work, and which we have found to be important in the control of tuberculosis in individual herds, may be summarized as follows:

1. The cattle should be tested with tuberculin, subcutaneous injection, and all of those giving a reaction should be removed. The reacting animals should be either destroyed, slaughtered for beef under proper inspection, or kept for breeding purposes, after the Bang method. The choice of procedure must depend upon existing conditions.

2. The herd should be retested at intervals of from six months to a year, and all reacting animals promptly removed.

3. Cattle for dairy or breeding purposes should be bought from sound herds only.

4. Animals that have once reacted should not be placed with sound cattle, although they may cease to react and remain well to all appearances.

5. Milk from cows of uncertain health should not be fed to calves unless previously sterilized.

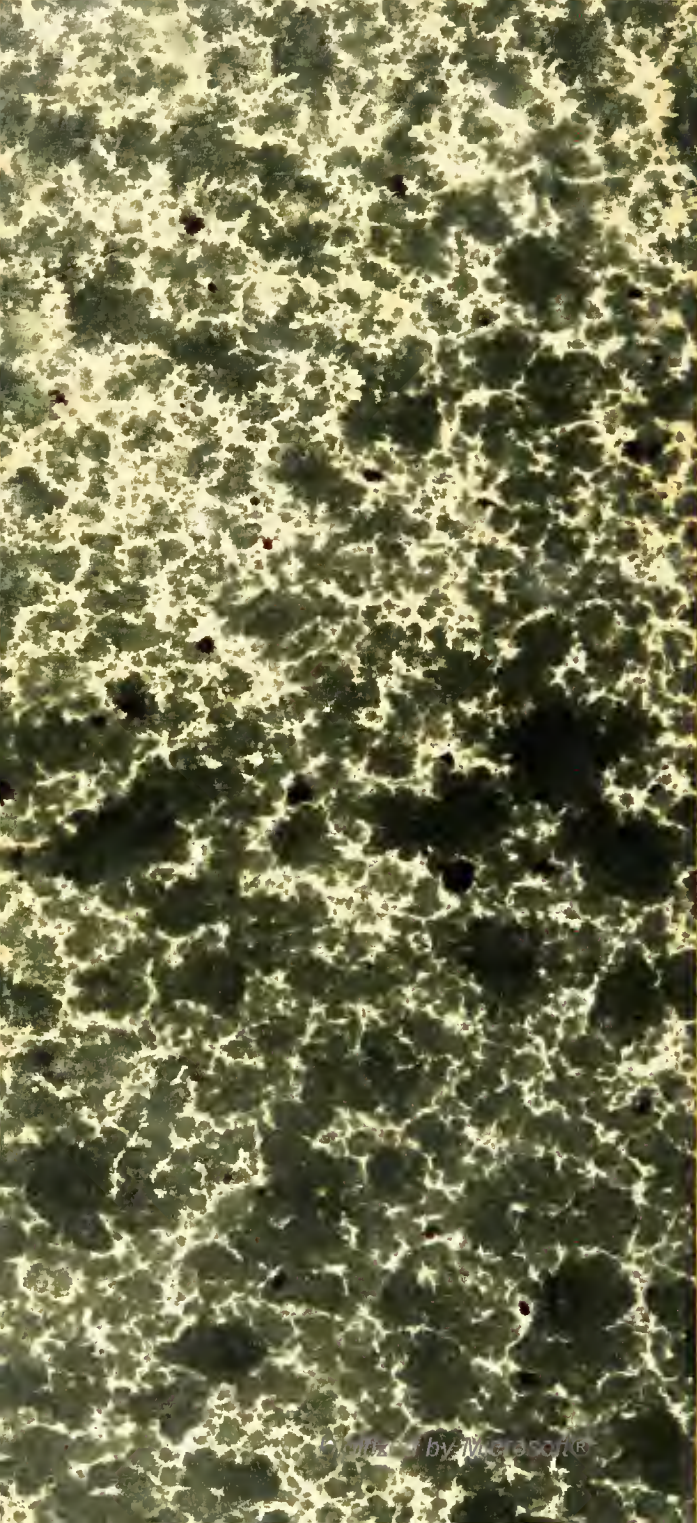
6. It is desirable that the owners keep a record of the tuberculin tests of their cattle made by competent veterinarians. Such a record of each animal is a valuable asset.

7. The application of tuberculin should not be trusted to unskilled persons.

8. In eradicating tuberculosis the individual herds are the units to deal with, and their owners must be held responsible for them.

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